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# Application of a combined superconducting fault current limiter and STATCOM to enhancement of power system transient stability

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ABSTRACT

Stable and reliable operation of the power system network is dependent on the dynamic equilibrium between energy production and power demand under large disturbance such as short circuit or important line tripping. This paper investigates the use of combined model based superconducting fault current limiter (SFCL) and shunt FACTS Controller (STATCOM) for assessing the transient stability of a power system considering the automatic voltage regulator. The combined model located at a specified branch based on voltage stability index using continuation power flow. The main role of the proposed combined model is to achieve simultaneously a flexible control of reactive power using STATCOM Controller and to reduce fault current using superconducting technology based SFCL. The proposed combined model has been successfully adapted within the transient stability program and applied to enhance the transient power system stability of the WSCC9-Bus system. Critical clearing time (CCT) has been used as an index to evaluate and validate the contribution of the proposed coordinated Controller. Simulation results confirm the effectiveness and perspective of this combined Controller to enhance the dynamic power system performances.



## 1. Introduction

The term transient stability usually refers to the ability of the parallel synchronous machines to remain in synchronism during the brief period following a large disturbance, such as a short circuit or important line tripping [1,2]. Actually and with the high integration of FACTS devices and renewable source in power system, the transient power system stability problem becomes complex and important subject for expert and researchers. Many technical solutions have been developed and applied to enhance the transient stability such as, power system stabilizer and FACTS technology [3]. Multi types of FACTS devices [4,5] have been proposed and installed with success in practical power systems to improve the transient power system stability such as: shunt Controllers (SVC, STATCOM), series Controllers (TCSC, SSSC) and hybrid Controllers (UPFC) [6–8]. FACTS devices allows to control individually or simultaneously voltage, active and reactive power flow.

Transient power system stability is related to the nature and the capacity of the fault current [9], during the last years many devices proposed to limit the fault current [10,11]. Recently application of superconducting technology in power systems attracted many experts and researchers and considered as an alternative to improve the dynamic performances of electrical networks [12]. Superconducting fault current limiter (SFCL) is one of recent project and has been expected to be a very potential solution to enhance the dynamic performances of power system [13-16]. Compared to many conventional fault current limiters, SFCL has many advantages such as automatic excessive current detecting and automatic recovering operation. Recently a significant review of recent application of SFCL in power system field is proposed in [17].

In this paper the SFCL coordinated with a shunt FACTS Controller (STATCOM) is investigated as a powerful combined controller for transient stability and voltage regulation enhancement of power systems. The reminder of the paper is organized as follows. A basic mathematical formulation of transient power system is presented in Section 2. The modeling of SFCL is presented in Section 3, a brief description of the STATCOM model is provided in Section 4. Optimal location of the proposed coordinated controller (SFCL–STATCOM) and computer simulation results for system under study are presented and discussed in Section 5.

## 2. Transient power system stability

The basic elements of a unit production shown in Fig. 1 are described briefly in this section. The multi-machine system representation considering the integration of multi-FACTS devices and multi-SFCL is shown in Fig. 2.

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